REMARKS

Claims 17-21 and 23-45 are pending in this application and were finally rejected in a Final Office Action mailed on February 6, 2006. Applicants wish to thank the Examiner for the productive personal interview with Applicants' representatives Adeel Akhtar and Adam Gilbert on October 24, 2006. The amendments and comments below reflect the agreement reached in the interview.

Claim Rejections

The pending claims stand rejected as anticipated by U.S. Patent No. 5,300,186 to Kitahara et al. ("Kitahara") and/or obvious in view of Kitahara alone or in combination with U.S. Patent No. 3,662,583 to Moore ("Moore"). While it was found that in Kitahara "the volume of the chamber is not explicitly taught," the previous Examiner concluded that Claims 17-21, 23-25 and 32-43 are anticipated because "the flow times explicitly taught read on moving multiple reaction space volumes of inactive gas through the reaction space for any reasonably sized reactor used for coating silicon wafers." Similarly, in response to Applicants' previous arguments the Examiner stated that "many references use relative flow times, wherein the purge flow time exceeds the reactant flow time by 2-10 times. This is also inclusive of 'at least two reactant space volumes.'" Applicants disagree.

In order to meet the claims and establish a prima facie case of obviousness (much less anticipation), a reference must teach all three of 1) purge flow rates, 2) purge duration and 3) reaction space volume. The relative duration of reactant and purge pulses is not sufficient. As Kitahara does not teach any reaction space volume, it is not possible to conclude that Kitahara meets this element of Claims 17 and 41. The relationship between reactant flow times and purge flow times recited in Kitahara provides no indication, in and of itself, of the reaction space volumes of gas moving through the reaction chamber.

As agreed in the interview, Applicants have amended independent Claims 17 and 41 (and relevant dependent claims) to clarify that the volume of purge gas is relative to the volume of the reaction chamber. In particular, the reaction space volume is now designated "X" in the claims and the volume of inactive gas moved through the reaction space in an interval between reactant pulses is at least "2X." Kitahara does *not* teach an atomic layer deposition process comprising

moving a volume of inactive gas equal to at least two times the reaction space volume (2X) through a reaction space in an interval between each two successive vapor phase reactant pulses.

Implicit in the rejections is the application of principles of inherency. However, Kitahara can not inherently teach the recited purge flow, whether under anticipation or obviousness. As Applicants have previously pointed out, "Inherency, however, may not be established by probabilities or possibilities. The fact that a given thing *may* result from a given set of circumstances ***is not sufficient.***" *In re* Oelrich, 212 U.S.P.Q. 2d 1597, 1599 (Fed. Cir. 2002), emphasis added. Without knowing the flow rate of the purge gas and the reaction space volume for a particular ALD process, there is no certainty and thus no way for a disclosed process to inherently anticipate the pending claims. The assertion in the Final Office Action that the ratio of purge flow times to reactant flow times would lead to moving at least two gas volumes through the reaction chamber between reactant pulses "for any reasonable sized reactor" is only a "probability or possibility" and thus clearly does not meet the well-established standard for inherency.

The Examiner appeared to recognize the limitations of the inherency rejections, stating that "In the event the applicant disagrees with the Examiners assessment of the flow rate inherently filling multiple reaction space volumes, it would have been obvious at the time the invention was made...to determine the volume of gas required to maximally remove the reactant gas and any residual component species." The Examiner supported this finding by stating that "one of ordinary skill knows that the longer one purges, the more reactant may be removed. To optimize the purge time with the cost of purge gas would have been at least obvious."

Applicants respectfully submit that one of skill in the art would have been using different criteria for determining the extent of purging than those used by Applicants to arrive at the claimed process. In particular, the skilled artisan would have been concerned with achieving self-limiting ALD reactions by complete separation of reactants, while achieving maximum throughput. Within the above constraints, the skilled artisan would have ***minimized*** the volume of purge gas directed into the reaction space to the lowest level necessary to avoid vapor phase interactions between reactants. By ***minimizing*** purge time, there is a cost savings in both the amount of gas needed and, more importantly, in increasing throughput. In addition, the skilled artisan would have been motivated to ***minimize*** the purge time in order to avoid disturbing the

previously adsorbed reactant and the growing film. This motivation is summarized, for example, Sakuma (U.S. 5,270,247, of record) which teaches that "By utilizing a hydrogen gas for purging, *the separation of different source gases is made more complete in shorter time, and this prevents damage to the once formed complete interface during the gas separation period...*" (column 5, lines 31-38, emphasis added). See also Ritala and Leskela (Handbook of Thin Film Materials 2002, pp. 103-159, courtesy copy attached) which teaches that "The minimization of purge times is one of the key aspects in a design of a productive ALD reactor" (page 141) and Lei and Barozzi (J. Vac. Sci. Technol. 24(2):780-789 (2006), courtesy copy attached) which states that "Minimizing reactant exposure and purge time is critical in ALD to achieve sufficiently high throughput for manufacturing" (at page 784).

In contrast, the present application recognizes that there is a benefit in reducing contamination that is obtained by optimization that is not merely guided by a desire to achieve self-limiting reactions. In particular, Applicants recognized that a purge selected to remove reactants from the walls of the reaction space improved film quality. See publication at paragraphs [0040]-[0043]. The recognition of a particular problem to be solved, removing reactants from the walls (and not merely in the void) of the reaction space, as recited in the claims, leads to a different criteria for determining the amount of purging. Without this recognition, optimizing the purge time would ***not*** result in the claimed invention as it would be seen to unnecessarily increase purge time and reduce throughput.

Applicants note that even a recognition that contamination generally is a problem would not lead to the present invention as there are many ways of dealing with contamination other than adjusting purge time, such as increasing the purity of the reactants. See Ritala and Leskela, supra, at page 109: "A crucial aspect of the transport gas is purity because it is the main source of impurities in an ALD process."

With particular reference to Kitahara, there is no teaching or suggestion in Kitahara that would lead the skilled artisan to optimize the purge time at all, much less to optimize the purge time to move at least two times the reaction space volume (2X) of purge gas through the reaction space between reactant pulses. Kitahara did not recognize the problems associated with conventional ALD methods that the Applicants have addressed and thus would have applied different criteria in achieving the balance: they would have optimized the purge time only for

separation of gas phase reactants with maximum throughput, rather than removal of adsorbed reactants from the walls of the reactor. As a result, there is no motivation to modify Kitahara to arrive at the claimed amount of purging.

There are no references of record that recognize any problem associated with contamination from adsorbed reactant particles on reaction space walls. The skilled artisan, operating under the teachings of Kitahara and the general knowledge in the art and without the hindsight benefit of Applicants invention, would have no reason to optimize the purging time of Kitahara to arrive at the recited extent of purging. As a result, the rejection of Claims 17 and 41 should be withdrawn. In addition, as the remaining claims depend from Claim 17 or 41 and contain all of the features thereof in addition to further distinguishing features, Applicants submit that all claims are in condition for allowance.

With respect to Claims 26-31, which were rejected over the combination of Kitahara and Moore, Applicants note that Moore does not make up for the deficiencies of Kitahara described above.

Finally, Applicants again traverse the rejection of Claim 41 on the additional ground that Kitahara does not teach or suggest an atomic layer deposition process comprising in a first pulse flowing only an inactive gas directly into the reaction chamber through a second inflow channel ***while*** flowing a first vapor-phase reactant into the reaction chamber through a first inflow channel, and in a second pulse flowing only an inactive gas into the reaction chamber through the first inflow channel ***while*** flowing a second vapor-phase reactant into the reaction chamber through the second inflow channel, as claimed. Claim 41 recites this sequence in combination with "moving a volume of at least 2X" between reactant pulses. Kitahara teaches alternately and sequentially feeding into a reaction chamber trimethyl aluminum (TMA), hydrogen (H_2), and arsine (AsH_3). *See* Kitahara, col. 4, lines 56-68 to col. 5, lines 1-4. In fact, in Fig. 3 of Kitahara, the H_2 pulse does not overlap with either the TMA pulse or the arsine pulse. This deficiency is not made up for by any secondary reference. Thus, Applicants respectfully request withdrawal of the rejection of Claim 41, and Claims 42-45 which depend therefrom.

CONCLUSIONS

In view of the foregoing remarks, Applicants respectfully submit that the present application is in condition for allowance and request the same. If, however, some issue remains

that the Examiner feels can be addressed by Examiner's amendment, the Examiner is cordially invited to call the undersigned for authorization.

Respectfully submitted,

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